

which has to be multiplied by the coefficient for collimation-error. Even this use of the instrument saves considerable time, and for stars near the pole, as *Polaris*, I find it to be somewhat more accurate than the ordinary method.

"The construction of the instrument, which required no little nicety of workmanship, has been executed for me by Mr. Simms in a very satisfactory manner.

"If the instrument be used in a latitude different from that for which it was constructed, a slight additional calculation will be required for determining the position of the point P, which may be performed by the instrument itself. For if l be the colatitude of the observatory for which the instrument was made, and z the zenith distance of an object, and if l' , z' be the corresponding arcs for another observatory, we have,

$$\begin{aligned} a + b \cos z' + c \sin z' &= a + b' \cos z + c' \sin z, \\ \text{if } b' &= c \sin (l - l') + b \cos (l - l') \\ \text{and } c' &= c \cos (l - l') - b \sin (l - l') \end{aligned}$$

Hence b' and c' are the co-ordinates of P to be used at the latter place."

*Description of an Instrument for obtaining the Corrections to be applied to Transit Observations.** By Mr. R. C. Carrington, of the Observatory, Durham.

Mr. Carrington, having heard that Professor Challis had proposed an instrument for correcting transit observations, set himself to work to solve the same problem. Finding his construction different from that of Professor Challis, he has had his instrument executed by Messrs. Troughton and Simms, and presented it to the Astronomical Society.

Expanding the usual formula, viz.

$$\frac{c}{\sin \delta} + \frac{i \cos (\delta - l)}{\sin \delta} + \frac{a \sin (\delta - l)}{\sin \delta},$$

(c , i , and a being the collimation, inclination, and azimuth corrections in units of 15",)

Mr. Carrington arrives at the equivalent formula,

$$\begin{aligned} c'' + c' \cotan \delta + c \operatorname{cosec} \delta; \text{ where } c \text{ remains as before, and} \\ c' = i \cos l - a \sin l, \text{ and } c'' = i \sin l + a \cos l. \end{aligned}$$

The geometrical construction on which Mr. Carrington's instrument depends, is this.

* In May last, the President particularly called the attention of the meeting to Mr. Carrington's instrument, and to Mr. Johnson's beautiful and accurate annual volume of observations.

Draw an indefinite right line divided into a scale of equal parts each representing 1^s . Cut off from the beginning a portion $= c''$; at the point of section erect a perpendicular which make $= c'$, draw from the extremity of this perpendicular a line making an angle $= 90 - \delta$ with it, and also draw a parallel to this line at the distance c from it; the last-drawn line will cut off from the original line a part equal the sum of the corrections. For, as will be easily seen, the intercepted points by the two parallel lines are respectively the cotangent and cosecant of δ to the respective radii c' and c .

The foregoing construction is very ingeniously reduced to practice by Mr. Carrington, but it would not be easy to make the matter intelligible without drawings.

Any person who is interested in the subject may inspect the instrument, and Mr. Carrington's explanation of its use, at the Society's apartments. Mr. Carrington "believes that the instrument will work to two places of decimals for all stars not less than 5° distant from the pole, and that a mistake in sign, or in the place of the decimal points, is rendered impossible." Mr. Carrington adds, "I allude to Professor Challis's instrument merely to recall the fact that his preceded mine."

Note on correcting Series of Transit Observations for Instrumental Error. By Mr. Sheepshanks.

The mechanical contrivances of Professor Challis and Mr. Carrington for this purpose, induce me to mention a method which, under certain circumstances, I found very convenient for freeing transit observations from instrumental error. Starting from the well-known formula, that the sum of corrections may be represented by $m + n \tan \text{Dec} + c \sec \text{Dec}$ (m and n are, with me, unknown quantities, to be determined from the observations themselves, c the unknown correction for collimation), I observed a large number of stars on one night, and the same stars on a following night, *with the instrument reversed*. Then, since the collimation changes its sign, and the new values of m and n have the same factors as before, the observed place of the star deduced from a *mean* of the two nights, required a correction of $m' + n' \tan \text{Dec}$, the collimation being eliminated. If the rate of the clock was considerable, the observations were corrected for rate before taking the means. I then selected the Greenwich stars near the pole, *Polaris* or δ *Ursæ Minoris* if possible, and the Greenwich stars near the equinoctial, and from these two groups obtained the value of m' and n' , which were generally found with extreme accuracy. All the unknown stars were then corrected by applying $m' + n' \tan \text{Dec}$ to their mean results from the two nights' observations.

To facilitate the computation, I had cards printed of the natural tangents and secants of declination to 90° . (These may be procured at the Society's apartments.) The advantages are that in *cataloguing* you save the trouble of determining the level